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(54) [Title of the Invention] INK TANK FOR USE WITH  
RECORDING HEAD, RECORDING HEAD CARTRIDGE, AND RECORDING  
DEVICE USING THE RECORDING HEAD

(57) [Abstract]

[Object] To provide an ink tank for use with a recording head, a recording head cartridge, and a recording device using the recording head, in which ink can be prevented from oozing along weld lines formed when the ink tank for use in an ink-jet cartridge is molded

[Solving Means] An ink tank for use in an ink-jet recording device, which is for use with a recording head in the ink-jet recording device, characterized in that the ink tank made from a molding resin has a concavity formed on the periphery of a tank-opening through which ink is supplied from the ink tank to the recording head, an ink-jet recording head provided with th ink tank, and an ink-jet

recording device having the recording head mounted thereon.

[Claims]

[Claim 1] An ink tank for use in an ink-jet recording device, which is for use with a recording head in an ink-jet recording device, characterized in that the ink tank made from a molding resin has a concavity formed on the periphery of a tank-opening through which ink is supplied from the ink tank to the recording head.

[Claim 2] An ink tank according to Claim 1, characterized in that the concavity is formed on the overall periphery of the tank-opening.

[Claim 3] An ink tank according to Claim 1, characterized in that the concavity constitutes a part of the tank opening.

[Claim 4] An ink tank according to Claim 1, characterized in that ink supplied into the ink tank has a color different from that of the ink tank.

[Claim 5] An ink jet recording head for use in an ink-jet recording device, characterized in that the recording head is provided with the ink tank specified in any one of Claims 1 to 4.

[Claim 6] An ink-jet recording device provided with a recording head, characterized in that the recording head is the ink-jet recording head specified in Claim 5.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to an ink tank for use in an ink-jet recording device to carry out recording by an ink jet system, an ink-jet recording head using the ink tank, and an ink-jet recording device having the recording head.

[0002]

[Description of the Related Art] Conventionally, printing by an ink-jet system has been attractive due to its advantages in that noises generated at printing can be reduced to be negligible, high speed printing can be made, ink can be fixed onto ordinary paper-sheets without particular process being required.

[0003] Particularly, according to the ink-jet print systems disclosed in Japanese Patent Laid-Open No. 54-51837, Deutsches Patent Offenlegungsschrift (DOLS) No. 2843064, heat energy is applied to a liquid, so that a driving power for the discharge of the liquid is attained. This characteristic is different from that of printing methods which are carried out in other ink-jet systems.

[0004] According to the print methods disclosed in the above-described laid-open patent specifications, the liquid, which is affected by the application of heat energy, changes in its state with the volume being steeply increased. The action force, produced by the change of the state, causes the liquid to discharge through the orifices in the top of a

recording head of a printer. Thus, liquid droplets are formed, and adhere to a recording medium such as recording paper or the like.

[0005] Especially, the ink-jet print method disclosed in DOLS No. 2843064 can be effectively applied as a so-called drop-on-demand print method. Moreover, the recording head can be easily realized as a head for the high density multi-orifices of a line printer, and thus, images with a high resolution and high qualities can be attained at a high speed.

[0006] The recording head of a printer to which the above-described print method is applied contains orifices formed to discharge droplets, an ink discharge portion connected to the orifices and containing a liquid stream to partially constitute a heat action portion in which heat energy is applied to a liquid so that liquid droplets are discharged, and a recording head substrate containing an electricity-heat conversion member (heating member) as means for generating heat-energy.

[0007] Fig. 2 is a perspective view of a conventional ink-jet cartridge. The ink-jet cartridge comprises a head 202 having a discharge portion 202a, and an ink tank 203 for supplying ink to the head 202. Moreover, a color type ink-jet head cartridge in which plural ink tanks and plural heads are integrated with each other as shown in Fig. 3 has

been practically applied.

[0008]

[Problems to be Solved by the Invention] The present invention has been devised to solve the problems which occur especially in a color ink-jet head cartridge as shown in Fig. 3. An ink tank 112 is a molded product of resin. As the resin, Noryl resins or the like are often used. If holes represented by reference numeral 101 or the like are formed in the ink tank, shallow damages in streak-shapes like micro-cracks are generated at the surface of the ink tank. The damages are called weld lines. The weld line causes no problems in the function of the ink tank. In this case, the reference numeral 101 is an opening through which ink is supplied from the ink tank to the ink-jet head.

[0009] If ink for the ink-jet head adheres to the weld lines, the ink runs along the weld lines due to the capillary force. In the tank of a ink-jet head cartridge, the openings are in contact with the ink. The ink flows along the weld lines extending from the openings. In some cases, probably, cracks generate on the ink tank as seen at 401 in Fig. 4. In the case of a monochrome ink tank, the "cracks" are not appreciable, if the color of the ink and that of the tank are the same. However, if the ink tank has multi-colors as shown in Figs. 1 and 3, some colors are different from that of the ink, and thus the cracks are

appreciable.

[0010] Conventionally, no problems occur, since the color of the ink tank is black. In recent years, colorization has been often applied. Thus, the ink tanks of color heads have colors other than black to be discriminated from black-color heads and to improve an image as color heads.

[0011] To eliminate weld lines, a method of treating the weld lines with xylene or the like after the ink tanks are molded is proposed. In this case, this method is additionally carried out, and thus, the cost increases. Moreover, a method of selecting molded products based on the generation of welds is proposed. In this case, the yield is reduced, and thus, the cost increases.

[0012] In view of the above-described conventional examples, the present invention has been devised. The present invention is related to a color ink-jet cartridge. It is an object of the present invention to provide a recording head ink tank which can be prevented from being stained with ink along weld lines formed when the ink tank is molded, and to provide a recording head cartridge and a recording device using the recording head.

[0013]

[Means for Solving the Problems] The above-described object is achieved by the present invention which is described as follows. That is, the present invention discloses an ink

tank for use in an ink-jet recording device, which is for use with a recording head in an ink-jet recording device, characterized in that the ink tank made from a molding resin has a concavity formed on the periphery of a tank-opening through which ink is supplied from the ink tank to the recording head.

[0014] The ink tank is characterized in that the concavity is formed on the overall periphery of the tank-opening, the concavity constitutes a part of the tank opening, and ink supplied into the ink tank has a color different from that of the ink tank.

[0015] Moreover, the present invention discloses an ink jet recording head for use in an ink-jet recording device, characterized in that the recording head is provided with the ink tank of the present invention, and also discloses an ink-jet recording device provided with a recording head, characterized in that the recording head is the ink-jet recording head of the present invention.

[0016] To achieve the above-described object, in the ink tank of the present invention, a concavity as shown by 102 is provided on the periphery of a through-hole as shown by 101 in Fig. 1. Thus, the ink which oozes along weld lines is stopped in the concavity.

[0017]

[Embodiments] The present invention has great advantages



particularly in ink-jet recording systems, more particularly in ink-jet recording heads and ink-jet recording devices in which droplets are jetted for recording by utilization of heat energy. As for typical constitutions and principles of these recording heads and recording devices, suitably, the basic principles disclosed in U.S. Patents Nos. 4723129 and 4740796 is adopted.

[0018] Such a system adopting the principle can be applied to both of an on-demand type and a continuous type, and is especially effective for the on-demand type. The on-demand type system is as follows. That is, at least one driving signal to steeply rise temperature and sufficiently cause nucleus-boiling, in correspondence to recording information is applied to an electricity-heat conversion member arranged corresponding to a sheet holding a liquid (ink) contained therein and a liquid path. Thus, heat energy is generated in the electricity-heat conversion member, so that film-boiling is caused at the heat-action plane of the recording head, and thus, bubbles are formed in the liquid (ink) in a one-to-one relationship between the bubble and the driving signal. The growth and shrinkage of the bubbles causes the ink to discharge through the ink discharge ports, and thus, at least one droplet is formed and jetted.

[0019] In this case, if the driving signal has a pulse waveform, the growth and shrinkage of a bubble can be made

instantaneously and properly, when the signal is applied. Thus, the discharge of the ink can be performed at high responsibility. As the driving signal, a signal described in the specifications of U.S. Patent Nos. 4463359 and 4345262 is suitable. Moreover, by adopting the setting conditions of the invention described in U.S. Patent No. 4313124 and concerning the temperature rise ratio of the heat action plane described in the specification of U.S. Patent No. 4313124, the recording can be more sufficiently carried out.

[0020] Referring to the configuration of the ink-jet recording head, the configurations described in the above-described specifications, in which discharge ports, a liquid path, and an electricity-heat conversion member are combined (linearly liquid-path configuration or right-angular liquid path configuration) may be employed. In addition, the configurations disclosed in U.S. Patent Nos. 4558333 and 4459600, in which the heat action portion is arranged in a bend area, may be employed.

[0021] The present invention may be constituted, based on the configuration (disclosed in Japanese Patent Laid-Open No. 59-123670) in which a slit shared by plural electricity-heat conversion members functions as a discharge portion of the electricity-heat conversion members, and the configuration (disclosed in Japanese Patent Laid-Open No. 59-138461), in

which an opening which absorbs a heat energy pressure wave corresponds to a discharge portion, in addition to the above-described configurations.

[0022] Moreover, a full line type recording head may be used, of which the length corresponds to the maximum recording width at which the recording device can record. As for the full line recording head, plural recording heads as disclosed in the above-described specifications may be combined or integrated with each other.

[0023] Referring to other types of recording heads, exchangeable chip-type recording heads, which can be electrically connected to the body of a recording device, and to which ink can be supplied from the body of a recording device, may be used. Also, a cartridge type recording head integrated with an ink tank may be used.

[0024] It is preferable that a recovery Means and a preparatory auxiliary means for the recording head are added as unit components of the ink-jet recording device of the present invention, since the advantages of the present invention can be obtained with more stability. Specifically, these means include a capping means for the recording head, a cleaning means, a pressurizing and sucking means, a preparatory heating means, a preparatory discharge means, and so forth. Referring to the recording mode of the recording device of the present invention, the recording

device may be provided with a different-colors recording-mode and a mixed-color full-color recording-mode in addition to a recording mode using only a main-stream color, e.g., black color.

[0025] The ink which is a liquid is used in the above-description of the recording head and the recording device of the present invention. Ink which is solidified at a temperature lower than room temperature may be used in the present invention, provided that the ink can be softened or liquefied at room temperature or higher. In general, the temperature of ink is adjusted at a temperature of 30°C to 70°C. Thus, the viscosity of the ink is controlled to be in a range where the ink can be stably discharged. For example, the following ink is used. That is, the ink is a liquid in the above-described temperature range when a recording signal is applied, is liquefied due to the application of heat energy corresponding to the recording signal, is discharged in the form of liquid ink, and starts to be solidified the instance that the ink reaches a recording medium. The liquefaction of the ink is useful to prevent the temperature from rising due to excess heat energy. In addition, the ink is prevented from evaporating off, since the ink is solid at about room temperature, and the ink is solidified after the ink is discharged.

[0026] The above-described ink is held as a liquid or a

solid in concavities of a porous sheet or the like, which may be arranged in opposition to an electricity-heat conversion member (described in Japanese Patent Laid-Open Nos. 54-56847 and 60-71260). In the present invention, the film-boiling system is most effective for the above-described different types of ink.

[0027] The ink-jet recording device of the present invention may be provided as an image output terminal which is integrated with or separate from an information processor such as a word processor, a computer, or the like. In addition, the ink-jet recording device of the present invention may have a form of a copying machine in which the device is combined with a reader or the like, or a form of a facsimile device having a transmission and reception function.

[0028]

[Embodiments] Hereinafter, the present invention will be described in reference to the embodiments based on the drawings. The present invention is not restricted to these embodiments.

[0029]

[First Embodiment] Fig. 1 shows a first embodiment. In the drawing, an ink-jet head 111, an ink tank unit 112, an absorbing member 113 for holding ink, a tank lid 114, and an atmosphere-communication port 115 are shown. Moreover, an

opening 101 for supplying ink from the ink tank to the head, a concavity 102 dug in the outer peripheral portion of the ink tank in accordance with the present invention, and weld lines 103 extending from the opening 101.

[0030] Since the openings 101 is an ink supply port where ink exists at any time. The weld lines extend from the openings 101. Thus, the ink oozes along the weld lines, due to the capillary force. According to the present invention, a concavity is provided around the opening. The concavity functions as a buffer chamber, and the capillary force acts at two positions on the bottom side of the concavity in the direction orthogonal to the direction in which a weld line extends. Therefore, the ink is prevented from running along the weld lines further from the concavity.

[0031] The positions where the weld lines generate are substantially determined by the shape and size of an ink tank and the design of a mold. Preferably, the concavity is provided around the overall circumference of the opening. However, as described in this embodiment, the concavity provided at a particular position can achieve the function.

[0032] [Second Embodiment] Fig. 5 shows a second embodiment. As the concavity, triangular steps are provided. Thereby, the same advantages as in the first embodiment can be obtained. With the number of the triangular upheavals being larger, the oozing of the ink can be more effectively

stopped.

[0033] Hereinafter, an ink-jet printer (IJRA), which is a recording device having the above-described color ink-jet cartridge, will be described with reference to Fig. 6.

[0034] Fig. 6 is a perspective view showing an example of an ink-jet printer (IJRA) having a color ink-jet cartridge according to an embodiment of the recording head cartridge of the present invention.

[0035] In Fig. 6, a carriage HC is engaged with a spiral groove 5004 of a lead screw 5005 which rotates via driving-force transmission gears 5005 to 5011 in linkage with the rotation in the forward or backward direction of a driving motor 5013. The carriage HC having a pin (not shown) is supported by a guide rail 5003, and is reciprocated in the directions represented by arrows (a) and (b). An integration type ink-jet cartridge IJC (see Fig. 1) containing a recording head IJH and an ink tank IT is mounted on the carriage HC.

[0036] Reference numeral 5002 designates a pressing plate, which presses a recording sheet P against a platen 5000 along the movement direction of the carriage HC. Reference numerals 5007 and 5008 designate photocouplers, which are home-position detectors for detecting the presence of the lever 5006 of the carriage HC and exchange the forward and backward rotational directions of the driving motor 5013.

Reference numeral 5016 designates a member for supporting a cap member 5022 to cap the whole of the surface of the recording head IJH. Reference numeral 5015 is a suction device for sucking the inside of the cap member 5022, which carries out the suction for the recording head IJH via an opening 5023 inside the cap. These members constitute a head recovery device. The head is recovered according to the following suction recovery operation. Referring to capping the ink-jet cartridge IJC with the cap member 502, the ink is sucked by means of the sucking device 5015, and moreover, ink is fed under pressure by using an appropriate pressurizing means provided in the ink supply route to the ink-jet cartridge IJC. Thus, the ink is forcibly discharged through the discharge outlet, so that the viscose ink in the nozzle is removed therefrom. Moreover, the ink-jet cartridge IJC is protected by capping when the recording is finished and so on.

[0037] Reference numeral 5021 designates a lever which is used to start the suction for the suction-recovery. The lever 5021 is moved with the movement of a cam 5020 which is engaged with the carriage HC. The driving force from the driving motor is transmitted and controlled by a known transmission mechanism such as a clutch-exchanging mechanism or the like.

[0038] Reference numeral 5017 designates a cleaning blade,



and reference numeral 5019 designates a member for supporting the cleaning blade 5017 movably in the front-back direction. These members are supported by a supporting plate 5018 of the body. For cleaning, the cleaning blade 5017 is protruded into the moving route of the ink-jet cartridge IJC mounted onto the carriage HC. With the carriage HC being moved, the blade wipes off dews, wettings, dust and so forth on the discharge face of the cartridge therefrom. The cleaning blade 5017 is not restricted to the form shown in the drawing. Apparently, a well-known type cleaning blade may be used in this embodiment.

[0039] When the carriage HC is moved to a predetermined area on the home-position side, the above-described capping, cleaning, and suction recovery can be desirably made at respective corresponding positions. Thus, desired operation can be made at desired time.

[0040]

[Advantages] As described above, according to the present invention, a groove is provided around a through-hole of a molded product, so that ink can be prevented from oozing along weld lines. A color ink-jet head can be provided at a high yield and a low processing cost. Moreover, tanks can be provided with colors other than black-color. A color ink-jet cartridge can be easily discriminated from black-color heads, and moreover, the image of the color ink-jet

cartridge can be enhanced.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a schematic view of an example of an ink tank for use in an ink-jet cartridge of the present invention.

[Fig. 2] Fig. 2 is a perspective view of a conventional ink-jet cartridge.

[Fig. 3] Fig. 3 is a schematic view of an ink tank for use in a conventional ink-jet cartridge.

[Fig. 4] Fig. 4 is a schematic explanatory view which illustrates the problem of a conventional head.

[Fig. 5] Fig. 5 is a schematic view of another example of an ink tank of the present invention.

[Fig. 6] Fig. 6 is a schematic perspective view of a printer having the ink-jet cartridge of the present invention mounted thereon.

[Reference Numerals]

101; through-hole (opening)

102; concavity

103; weld line

111; ink-jet head

112; ink tank unit

113; absorbing member

114; tank lid

115, 204; atmosphere-communicating port

201; ink-jet cartridge

202; head

202a; discharge portion

203; ink tank

401; crack

FIG. 1 111. INK-JET HEAD 112. INK TANK UNIT 113.  
ABSORBING MEMBER 114. INK TANK LID 115, ATMOSPHERE-  
COMMUNICATION PORT

FIG. 2 201. INK-JET CARTRIDGE 202. HEAD 202a. DISCHARGE  
PORT 203. INK TANK

FIG. 3 1 111. INK-JET HEAD 112. INK TANK UNIT 113.  
ABSORBING MEMBER 114. INK TANK LID 115, ATMOSPHERE-  
COMMUNICATION PORT

FIG. 4 201. INK-JET CARTRIDGE 202. HEAD 202a. DISCHARGE  
PORT 203. INK TANK

FIG. 5 111. INK-JET HEAD 112. INK TANK UNIT 113.  
ABSORBING MEMBER 114. INK TANK LID 115, ATMOSPHERE-  
COMMUNICATION PORT

102. CROSS-SECTIONAL VIEW INK TANK ABSORBING MEMBER